MECHANICAL-PROPERTY DATA

MP 35 N

Work Strengthened and Aged Bar

Issued by

Air Force Materials Laboratory
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

Sept ..ber, 1970

Prepared by

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F33615-69-C-1115

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This data sheet was prepared by Battelle Memorial Institute under Contract F33615-69-C-1115. The contract was initiated under Project No. 7381, "Materials Application", Task No. 738106, "Engineering and Design Data". The major objectives of this program are to evaluate newly developed structural materials of potential Air Force weapons-system interest and then to provide data-sheet-type presentations of these data. The program was assigned to the Structural Materials Engineering Division at Battelle under the technical supervision of Mr. Walter S. Hyler. Project engineer was Mr. Omar Deel. The program was administered under the direction of the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, by Mr. Marvin Knight, project engineer.

Notices

MP35N Multiphase Alloy

MP35N is a new nickel-cobalt-chromium-molybdenum alloy developed by the E. I. duPont deNemours and Company, Incorporated. The rights to this alloy, MP35N, and the family of composition from which it was derived, MULTIPHASE (T) Alloys, were acquired by Standard Pressed Steel Company in 1967 and Latrobe Steel Company was subsequently licensed to manufacture the MULTIPHASE Alloys.

MP35N is hardened by work strengthening and aging to strength levels of 260 – 300 ksi. In addition to high strength and good ductility, the alloy is reported to have execellent resistance to corrosion and stress corrosion in salt water and other chloride solutions. Potential usage of this material is for fasteners, springs, marine drive shafts, cables, etc.

MP35N is available as ingot, billet, bar stock, wire, and tubing. A fabricator of flat-rolled products will be licensed soon so that all product forms will be available.

The composition of the 1-inch round bar stock used for this evaluation was as follows:

Ni – 35.24
Co – 35.11
Cr – 19.48
Mo – 9.61
C – 0.015

The material was work strengthened and aged at 1050 F for 4 hours and air cooled to attain a nominal strength level of 260 ksi.

(T) Trademark of the Standard Pressed Steel Company.

MP35N ALLOY DATA[a]

CONDITION: WORK-STRENGTHENED AND AGED
THICKNESS: 1-INCH DIAMETER ROUND BAR

Properties	Temperature, F			
	RT	400	700	1200
<u>Tension</u>				
F_{tu}, ksi	273.0	245.0	228.0	189.3
F_{tu}, Notched (K_t = 6.3), ksi	304.1	--	--	--
F_{tu}, Notched (K_t = 9.0), ksi	284.1	--	--	--
F_{ty}, ksi	263.0	238.3	221.0	155.0
e_t, percent in 2-in.	11.3	11.0	8.3	19.7
RA, percent	53.5	51.2	42.5	23.2
E_t, 10^6 psi	35.9	32.7	32.7	23.6
<u>Compression</u>				
F_{cy}, ksi	253.0	211.0	197.0	150.0
E_c, 10^6 psi	33.9	32.5	29.3	23.8
<u>Shear</u>				
F_{su}, ksi	144.7[b]	U[c]	U	U
<u>Impact</u> (v-notch charpy), ft-lb	24.0	20.5	14.6	U
<u>Fracture Toughness,</u> K_{Ic}[d]	78.7	U	U	U
<u>Axial Fatigue</u>[e]				
Unnotched, R = 0.1				
10^3 cycles, ksi	273	264	258	U
10^5 cycles, ksi	194	184	180	U
10^7 cycles, ksi	157	140	134	U
Notched (K_t = 3.0), R = 0.1				
10^3 cycles, ksi	204	188	170	U
10^5 cycles, ksi	80	74	68	U
10^7 cycles, ksi	45	50	60	U

Properties	Temperature, F RT	700	900	1200
Creep				
	NA	222	130	35
	NA	221	103	25
Stress Rupture				
	NA	223	212	97
	NA	222	209	75
Stress Corrosion				
80% F_{ty}, 1000 hrs. Max.	No Cracks[f]			
Coefficient of Thermal Expansion				
10^{-6} in/in/F	7.1 (70-200 F)			
	8.2 (70-600 F)			
	8.7 (70-1000 F)			
Density				
0.304 lb/in^3				

(a) Data are average of at least three tests conducted at Battelle under the subject contract unless otherwise indicated. Fatigue, creep, and stress-rupture values are from curves generated using a greater number of tests.

(b) Double-shear pin-type specimen, 0.250-inch diameter.

(c) U, unavailable; NA, not applicable.

(d) Average of 4 slow-bend tests.

(e) "R" represents the algebraic ratio of minimum to maximum stress in one cycle; that is, $R = S_{min}/S_{max}$. "K_t" represents the Neuber-Peterson theoretical stress concentration factor.

(f) 3-point bend test. Alternate immersion 3-1/2 percent NaCl.

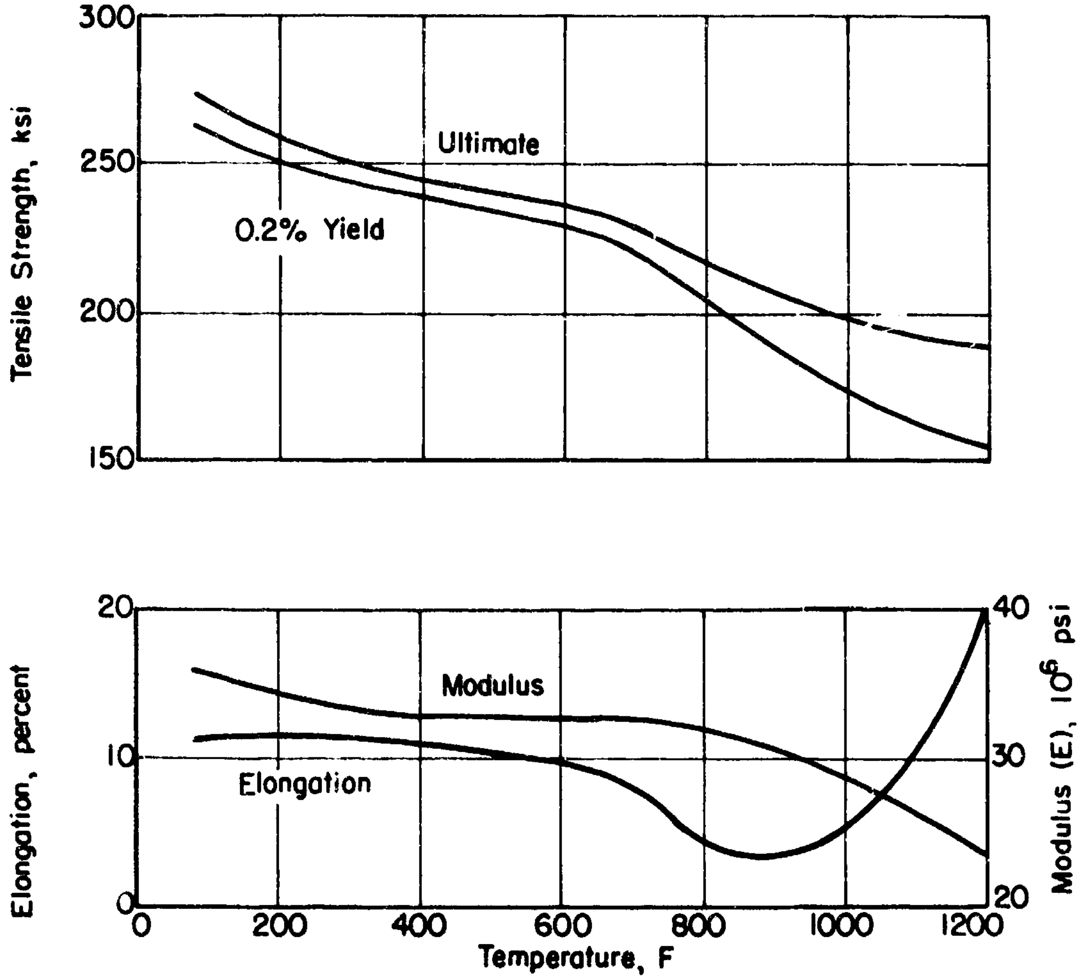

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF MP35N MULTIPHASE ALLOY BAR

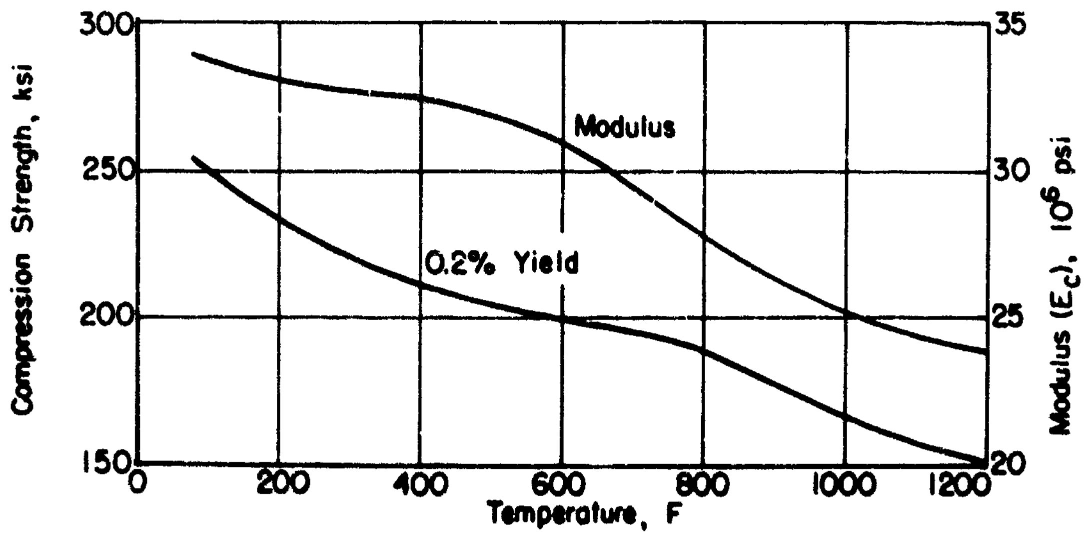

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSION PROPERTIES OF MP35N MULTIPHASE ALLOY BAR

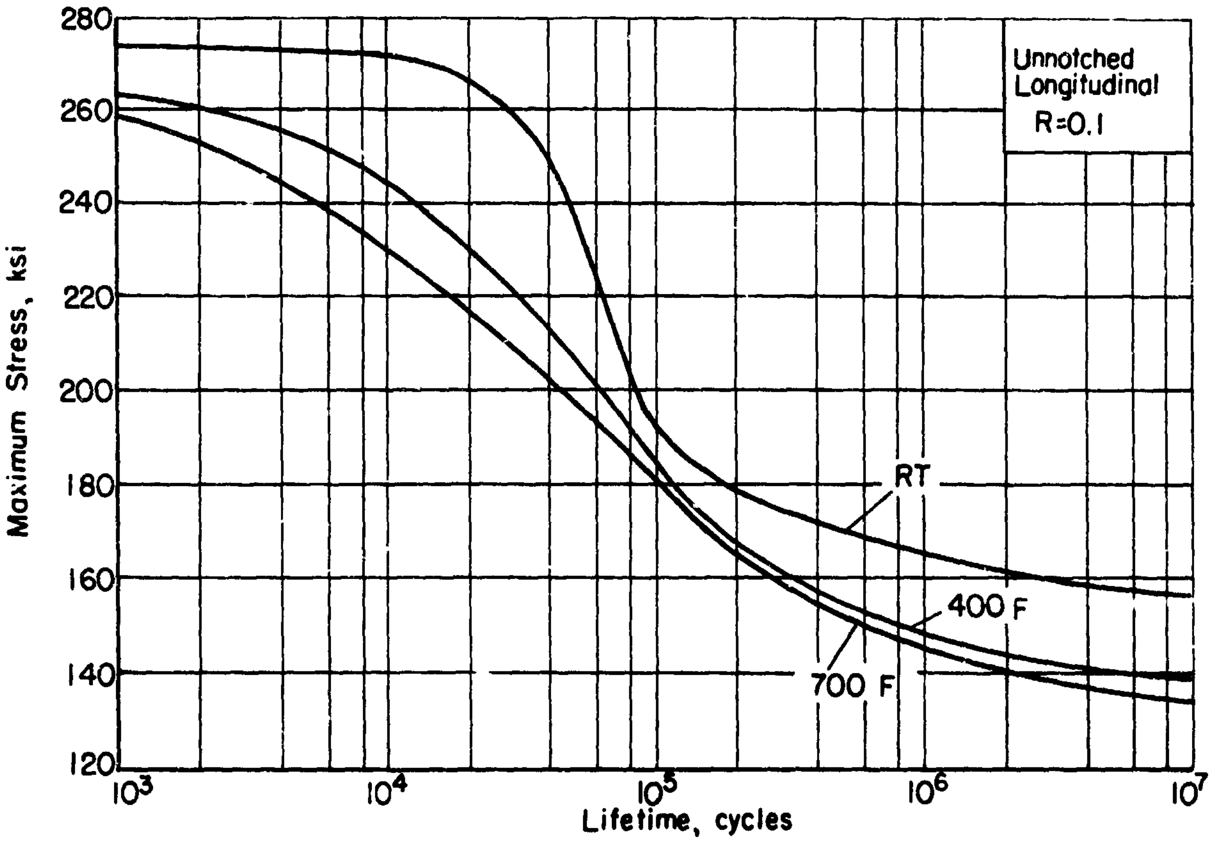

FIGURE 3. AXIAL LOAD FATIGUE RESULTS FOR MP35N MULTIPHASE ALLOY BAR AT THREE TEMPERATURES

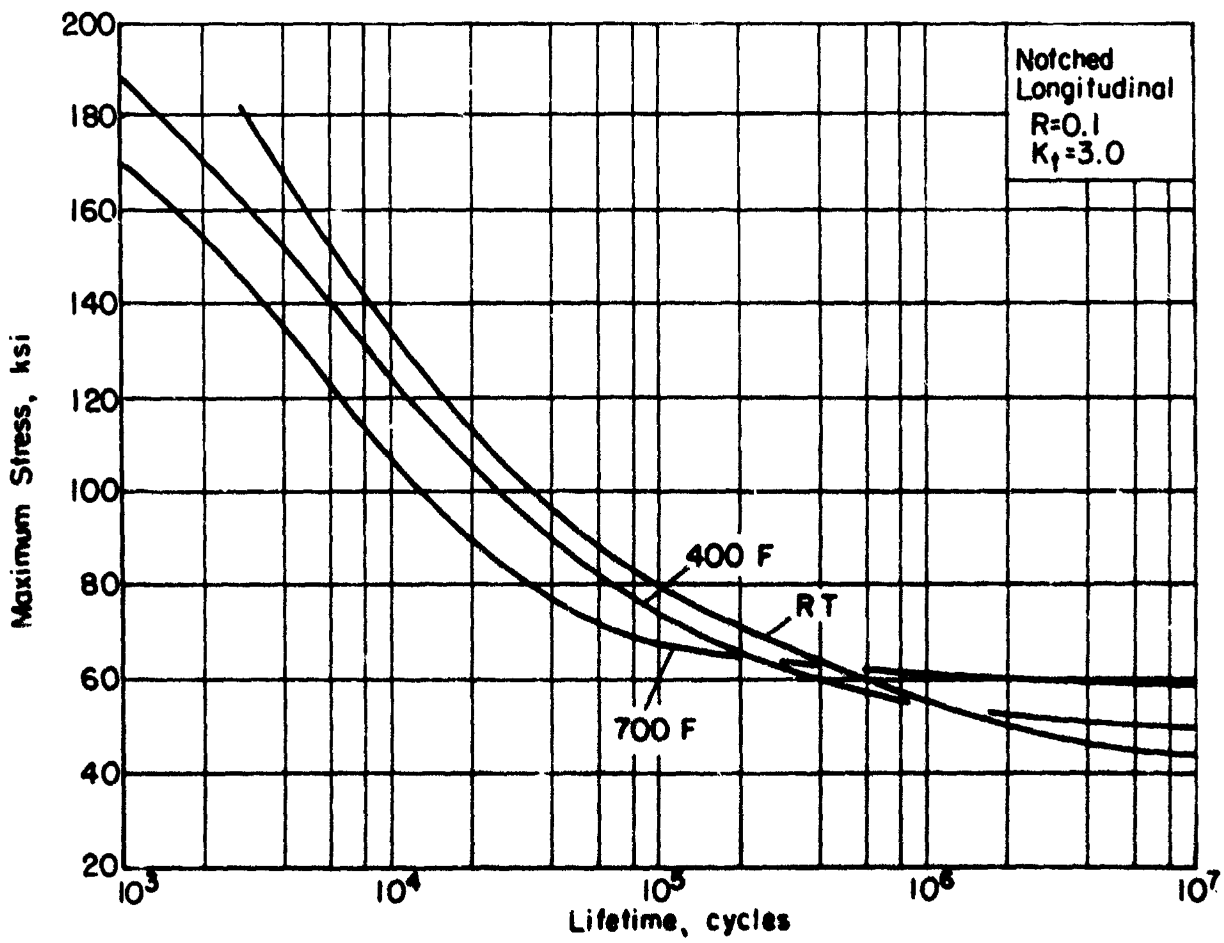

FIGURE 4. AXIAL LOAD FATIGUE RESULTS FOR NOTCHED (K_t = 3.0) MP35N MULTIPHASE ALLOY BAR AT THREE TEMPERATURES

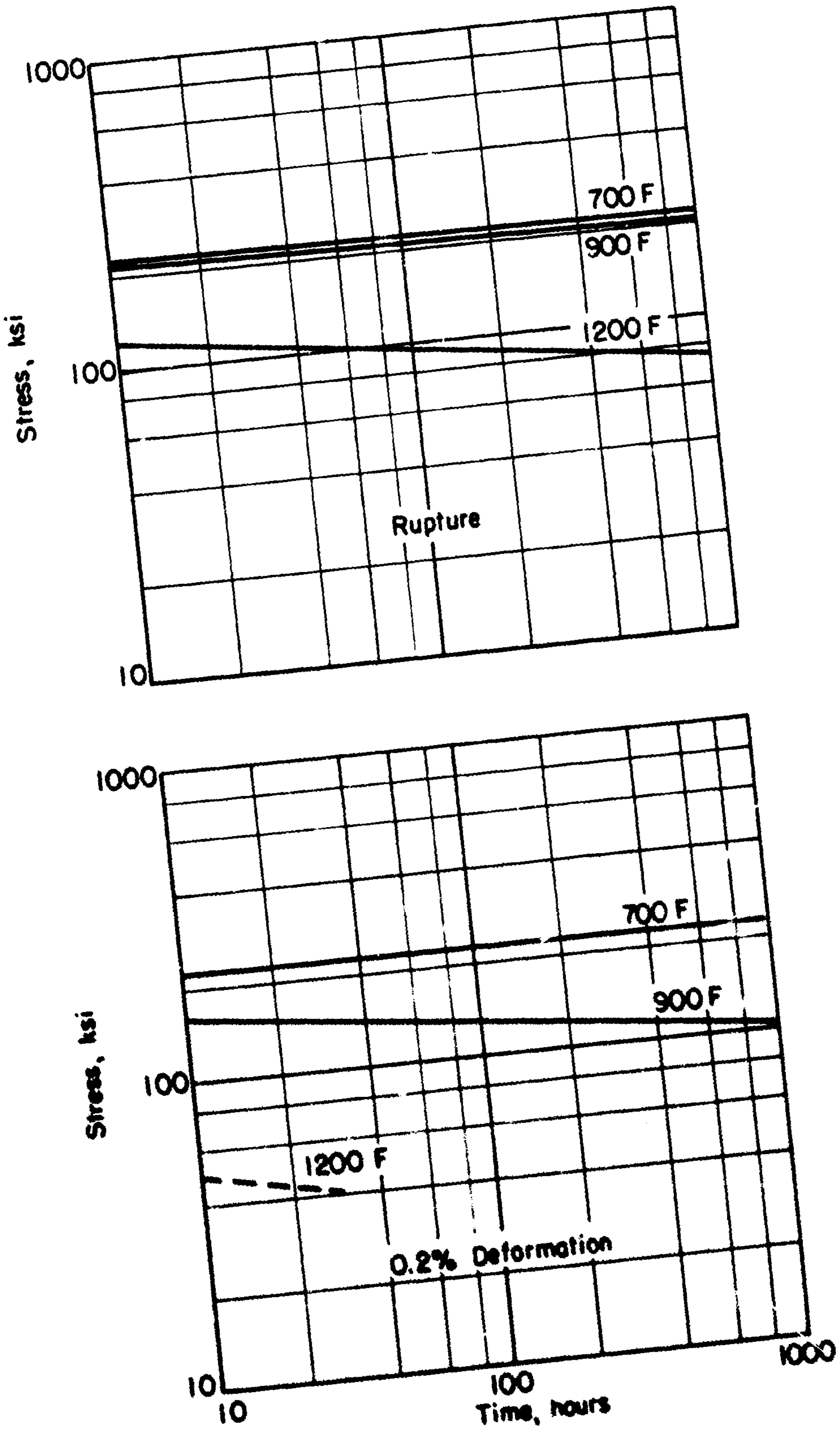

FIGURE 5. STRESS-RUPTURE AND PLASTIC DEFORMATION CURVES FOR MP35N MULTIPHASE ALLOY BAR

References

(1) Trade Literature, "Lescalloy MP35N Multiphase", Latrobe Steel Company.

(2) Hood, A. C., "MP35N ... A Multiphase Alloy for High Strength Fasteners", Metal Progress (May, 1968).

(3) Smith, G. D., and Yates, D. H., "High Strength--Ductility--Corrosion Resistance--Multiphase Alloys Have all Three", Metal Progress (March, 1968)

(4) Fletcher, S. G., and Yates, D. H., "Multiphase: A Unique Alloy System for High Strength and Corrosion Resistance", paper presented at Materials Engineering Congress and Exposition, Detroit, 1968.

(5) Hagan, F., "Physical Property Data on Multiphase Bolts", Report No. 1740, Standard Pressed Steel Laboratory Report (July 12, 1968)